16 SURVEILLANCE

Following are definitions of the terms used in the surveillance architecture:

Independent Surveillance: The use of primary radar to independently detect and determine the range and azimuth (2-dimensional position) of aircraft by means of reflected radar energy. Airport surface detection equipment (ASDE) primary radars are used to determine the position of aircraft and vehicles operating on airport taxiways and runways. Primary radar surveillance is *independent* because aircraft or ground vehicles need not be equipped with any enabling avionics to be detected.

Cooperative Surveillance: The use of secondary surveillance radar (SSR) to determine the position, assigned beacon code (4,096 codes are currently available), and in most cases, the barometric altitude of an airborne aircraft by interrogation of a transponder onboard the aircraft. Because the aircraft must be equipped with a transponder, SSR technology is deemed to provide *cooperative* surveillance. Mode-3/A transponders reply with only the assigned code. Mode-3/C transponders (the most common type) reply with both assigned code and altitude. Mode-Select (Mode-S) transponders reply with assigned code and barometric altitude to all SSR interrogators and also include a discrete, permanently assigned address when replying to Mode-S interrogators. The Mode-S system also permits additional data to be exchanged between aircraft and Mode-S radars.

Automatic Dependent Surveillance:

- *Automatic Dependent Surveillance Broadcast (ADS-B):* The function on an aircraft or surface vehicle that broadcasts position, altitude, vector, and other information for use by other aircraft, vehicles, and ground facilities.
- *Automatic Dependent Surveillance (ADS):* The use of ADS-B information by ground facilities to perform surveillance of airborne aircraft and aircraft or vehicles operating on the airport surface. This technology is deemed to provide *dependent* surveillance because it relies totally on each aircraft to determine its position (by means of the onboard navigation system) and report that position (and other data) via ADS-A or ADS-B communications equipment.
- *Automatic Dependent Surveillance Addressable (ADS-A):* A different form of ADS, designed to support oceanic aeronautical operations, based on one-to-one communications between aircraft providing ADS information and a ground facility requiring receipt of ADS reports. The term “ADS-A,” as used here is equivalent to “ADS” as discussed in International Civil Aviation Organization (ICAO) documentation.

Overview

The concept of operations (CONOPS) calls for surveillance of all controlled aircraft in the domestic airspace, using ADS and radar systems. ADS will be based on aircraft latitude/longitude position and velocity reports from the aircraft’s navigation system, barometric altitude, as well as short-term intent information (next way points). The CONOPS emphasizes the importance of ADS for both air-air and ground-based surveillance and extending instrument flight rules (IFR) separation services to nonradar areas of domestic airspace. The future cockpit applications for ADS-B include:

- Pilot situational awareness
- Separation assurance
- Limited shared responsibility for separation
- Safer airport surface operations in reduced visibility conditions.

The surveillance architecture will support Free Flight, provide increased surveillance coverage, improve safety, and increase airspace capacity. Changes in surveillance are designed to open airspace, allow for more direct routings, and increase NAS flexibility to meet growing demand.

The current domestic surveillance system consists of primary and SSRs that are used to detect aircraft and determine their position and identity. Air traffic control (ATC) automation systems process the radar data for display to air traffic controllers. Controllers use these data to separate aircraft flying under IFR from other aircraft, obstacles, terrain, and special use airspace and to provide weather advisory services. Weather detection functions provided by today's radar surveillance systems are discussed in Section 26, Aviation Weather.

The NAS surveillance architecture will use primary radars with digital technology for terminal airspace, but primary radars will be phased out of en route airspace. SSRs with selective interrogation (SI) capability will be used in both en route and terminal airspace. The SI capability allows the ATC automation, when modified, to utilize the unique Mode-S transponder identification code permanently assigned to an aircraft; eliminates false data from the controller's display; and supports use of Mode-S data link to provide traffic information service (TIS) to the cockpit.

The Mode-S data link will also enable use of a future Ground-Initiated Communications Broadcast (GICB) message. The accuracy of the position and intent information received from the aircraft via the GICB message is expected to significantly improve target tracking and the performance of controller tools such as conflict alert, conflict probe, and the Final Approach Spacing Tool (FAST). The GICB will capture the aircraft's ADS-B information in concert with the beacon interrogation. This allows independent verification of position, supports separation between ADS-B aircraft and those not equipped (especially important during transition), and allows the FAA to use the SSR network as part of a larger network of ground listening stations.

If enough users equip with ADS-B avionics, ADS-B for air-air surveillance will be implemented in domestic and oceanic airspace. Pilots are expected to use ADS-B air-air surveillance for situational awareness. In oceanic airspace, ADS-B may be approved as a means for pilots to conduct in-trail climbs, descents, and passing maneuvers.

If enough users equip, compatible ADS ground systems, which leverage off of the avionics equipage, will be implemented in domestic airspace (see Figure 16-1). Due to the characteristics of ADS-B (frequent broadcast of position), ADS-B-based surveillance is expected to be the most accurate form of surveillance, potentially allowing minimum aircraft separation standards to be reduced. These surveillance improvements are expected to help expedite traffic flow in the NAS.

The CONOPS calls for implementing surveillance capability in oceanic airspace. In today's oceanic airspace environment, "procedural" separation between aircraft is managed by means of high frequency radio position reports provided verbally by pilots to controllers, indirectly through a third-party commercial communications provider. No means of direct oceanic surveillance is currently available. Consequently, the required lateral/longitudinal separation between aircraft in oceanic airspace is very conservative (between 60 and 80 nmi), and the capability to approve route and altitude changes is constrained.

ATC surveillance in oceanic airspace will be based on ADS-A reports to oceanic controllers via satellite communications (SATCOM), high frequency data link (HFDL), or other subnetworks. The reports, which are derived from Future Air Navigation System (FANS-1A) or aeronautical telecommunications network (ATN) avionics, include barometric altitude, latitude/longitude position, velocity, and short-term intent information (next way points). Ground equipment and automation will display the aircraft position and track to oceanic controllers, enabling current lateral/longitudinal separation standards to be reduced.

16.1 Surveillance Architecture Evolution

To ensure high availability of services in domestic airspace, the surveillance architecture provides at least two complementary means of surveillance. For example, if the aircraft navigational system associated with ADS-B malfunctions, beacon interrogation will continue to provide cooperative surveillance as a basis for separation. In oceanic airspace, surveillance will be provided by ADS-A communicated via SATCOM, HFDL, or other subnetworks.

Surveillance System Domains

Surveillance systems support four NAS domains: (1) en route, (2) oceanic, (3) terminal, and (4) tower/surface.

En Route Domain. A new SSR air traffic control beacon interrogator (ATCBI-6) with SI and the GICB feature will be installed at all ATCBI-4 and ATCBI-5 en route radar sites.

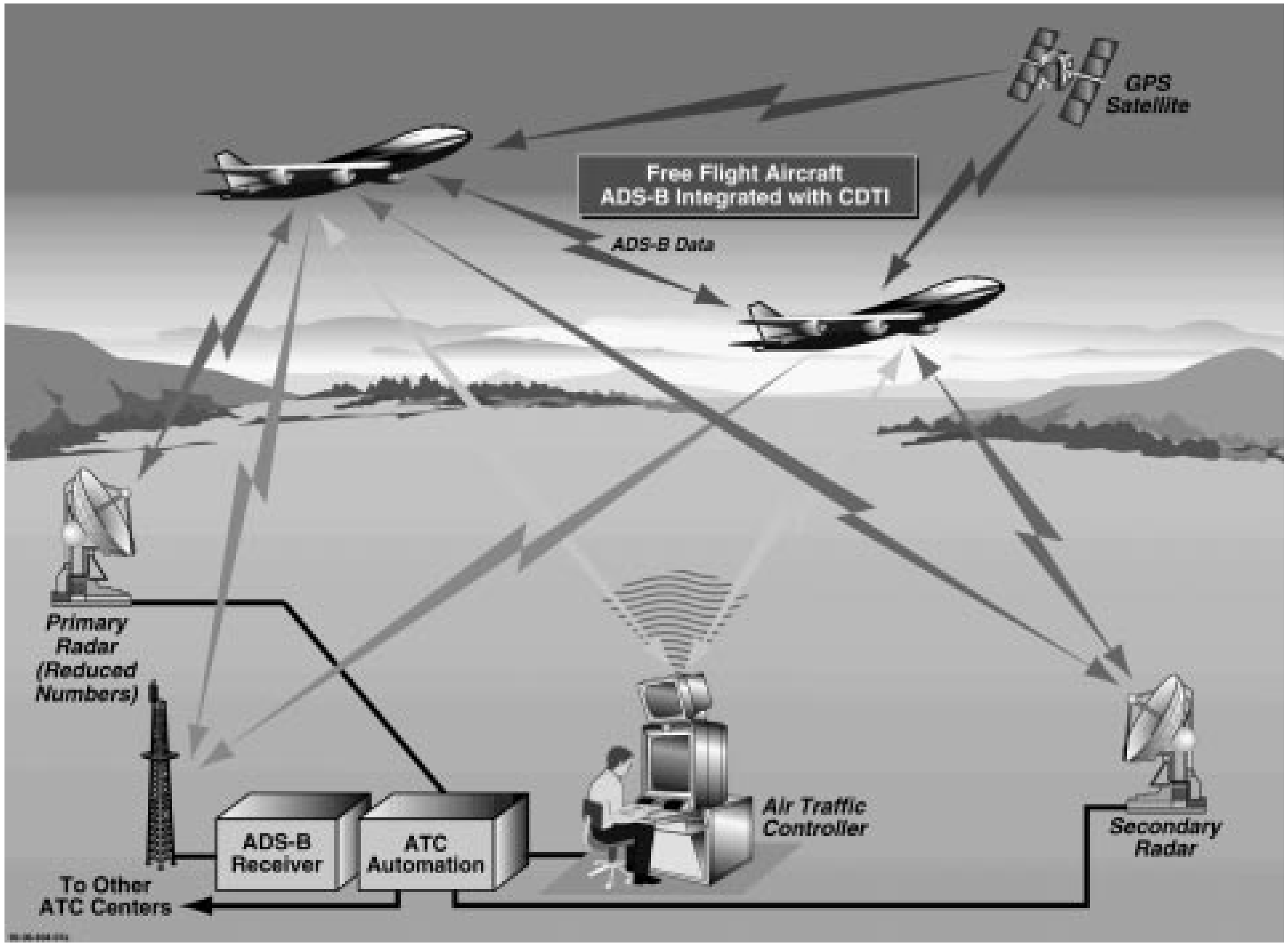

Figure 16-1. Proposed Surveillance System Architecture

The ATCBI-6 will work with Mode-3/A and 3/C transponders, enabling the ATC system to remain compatible with all users as they transition to ADS-B avionics. The Mode-S SSR will remain in service at 25 sites. They will be configured to provide TIS, a Mode-S data link service that provides automatic traffic advisories to properly equipped aircraft.

The SI capability of the Mode-S and ATCBI-6 radars will enable the air route traffic control centers (ARTCCs) to use Global Positioning System (GPS) data for surveillance via GICB. ADS capability will also be installed. The continued use of SSRs will enable the ATC system to maintain full service in domestic en route airspace whenever there is any difficulty with the ADS system. Continued use of SSRs also permits an extended transition period for general aviation (GA) in low-altitude airspace. Primary en route radars will be phased out of interior areas, except for those needed by the Department of Defense (DOD), or other agencies.

Oceanic Domain. ADS based on ADS-A will be implemented in oceanic airspace. SATCOM is emerging as the primary communications link for ADS-A and other oceanic communications, with HFDL likely to be used as an alternative source.

Terminal Domain. A new digital, combined primary/SSR system (airport surveillance radar (ASR)-11) will be deployed to complement the ASR-9/Mode-S system. The Mode-S will be configured to provide TIS. All ASR-11 integrated beacons will be upgraded to include SI and GICB capability. Terminal radar approach control (TRACON) facilities will begin to use ADS for surveillance. All three means of surveillance (primary radar, secondary radar, and ADS) will be retained in the terminal domain.

Tower/Airport Surface Domain. ASDE-3 will receive a service life extension. A new surface surveillance capability with conflict detection capability will be installed at additional airports. ADS capability for surface surveillance will also be installed. The accuracy of Wide Area Augmentation System (WAAS)- and Local Area Augmentation System (LAAS)-derived ADS-B (with LAAS taking precedence) is expected to enable the ADS system to support substantial airport surface operations in reduced visibility conditions. The airport surface ADS system will also feature a multi-lateration capability that uses aircraft transponder replies, triggered by the terminal SSR or local interrogators, to determine the identification and the position of non-ADS-B aircraft on the airport surface. Adding multi-lateration provides an alternate means of surveillance in absence of ASDE.

16.1.1 Surveillance Architecture Evolution—Step 1 (1998)

En Route Domain. Various models of air route surveillance radar (ARSR-1, -2, -3, and -4) and several military fixed position surveillance (FPS) (military primary radar) types are used to provide primary radar surveillance for the ARTCC. These radars are positioned to support major airways and provide surveillance coverage within a 200- to 250-mile radius with 10- to 12-second update rates. Except for the ARSR-4, many of these radars have been in service for 30 years and are costly to operate and maintain. The ARSR-4 radars in the continental United States and the FPS-117 radars in Alaska are jointly used by the FAA and the Air Force for ATC and air defense, respectively.

Two types of SSRs are used: the ATCBI-4 and -5 and the Mode-S. Nearly all SSRs are co-located with en route primary radars and operate at equivalent ranges and update rates. Twenty-two SSRs operate as stand-alone radars supporting ARTCCs. The ATCBI-4s and -5s are reaching the end of their service lives and will be replaced.

Oceanic Domain. In current operations, pilot position reports are made to a commercial service via high frequency (HF) voice communications. They are then forwarded to FAA oceanic ATC centers where the reported positions are displayed to controllers. Some pilot position reports are currently being transmitted from FANS-1/A-equipped aircraft via satellite data link using controller-pilot data link communications (CPDLC) messages to some oceanic sectors.

Terminal Domain. Three models of airport surveillance radar (ASR-7, -8, and -9) are positioned on airports to provide surveillance coverage (55-mile radius with a 5-second update rate) for TRACONs. The analog ASR-7 and -8 radars, which have been in service since the 1970s, are incompatible with the future digital terminal automation system, the Standard Terminal Automation Replacement System (STARS). Two types of SSRs are used in the terminal domains: the ATCBI -4 and -5 and the Mode-S. They are all co-located with ASRs and operate at equivalent ranges and update rates.

Tower/Airport Surface Domain. ASDE radars, used to provide primary radar surveillance of aircraft and vehicles on airport runways and taxiways to air traffic control towers (ATCTs), are being installed at the 34 busiest U.S. airports. The Airport Movement Area Safety System (AMASS), being installed at the same airports, works in conjunction with the ASDE-3 to alert tower controllers of impending runway incursions and other ground traffic problems. A parallel runway monitor (PRM) radar has been commissioned at the Minneapolis and St. Louis airports to monitor aircraft on approach to closely spaced parallel runways (separated by less than 4,300 feet).

16.1.2 Surveillance Architecture Evolution—Step 2 (1999–2002)

En Route Domain. The weather and radar processor (WARP) will enable weather data from the next-generation weather radar (NEXRAD) to be displayed to en route controllers on the display system replacement (DSR). This capability will allow en route primary radars to be shut down. Data from the ARSR-1, -2, -3, - 4, and FPS primary radars will not be used by FAA after WARP reaches full operating capability (FOC) (i.e., provides NEXRAD data to DSR) in early 2000. However, the long-range primary radars that support Department of Defense (DOD) operations (i.e., FPS-117 and ARSR-3 and -4 radars) may remain in use as required by DOD or other agencies. An ARTCC may receive data from suitably located terminal radar equipment, as needed, for supplemental coverage and gap filling.

The en route SSRs (ATCBI-4 and -5) will be replaced with a new ATCBI-6 with SI capability. ARSR-1, -2, and -3 and FPS site equipment and components, including the radar towers and pedestals, rotary joints, and shelters will require modification or replacement to allow compatibility with an SSR-only configuration.

Oceanic Domain. Oceanic sectors will continue to receive pilot position reports from FANS-1/A-equipped aircraft via satellite data link using CPDLC messages, as well as from HF voice communications.

Terminal Domain. The ASR-9 radars will receive a service life extension. The ASR-7 and -8 radars will be replaced by new digital ASR-11 radars delivered with a new monopulse SSR. Digital radars are required for interoperability with STARS.

To take early advantage of the information available in ADS-B avionics, the architecture plans for all SSRs to be equipped with a selective interrogation capability. The Mode-S sensors currently paired with ASR-7 and -8 radars will be "leap-frogged" to ASR-9 sites, so that all ASR-9s will be paired with SI-capable Mode-S SSRs. Mode-S sensors will receive a service life extension. All SSRs will remain compatible with the older Mode-A/C transponders, thus allowing time for aircraft to transition to ADS-B avionics.

TIS, a Mode-S data link service that provides automatic traffic advisories to properly equipped aircraft, will be implemented during this period. Pilots will be able to request and receive a display of nearby traffic. The relative range, bearing, and altitude (if known) and a "proximate" or "threat" classification of nearby aircraft will be displayed. This service will help pilots "see and avoid" other aircraft.

Tower/Airport Surface Domain. Installation of ASDE-3 radars to detect aircraft and vehicles on runways and taxiways will be completed at 34 airports. AMASS, which uses data from the terminal automation and ASDE-3 systems to alert tower controllers to potential traffic conflicts, will be installed at the same airports during this period. Installation of a new surface surveillance conflict detection system will begin at additional airports. This capability will further reduce the probability of traffic conflicts on airport surfaces and increase the efficiency of aircraft operations. Installation of PRMs at four additional airports is planned.

Additional Information. The user aviation community is currently investigating ADS-B for air-air surveillance. Several technologies—including 1090 MHz (Mode-S) squitter, self-organizing time division multiple access (STDMA) (also known as VHF digital link-Mode 4 or VDL-4), and Universal Access Transceiver (UAT)—are being tested. During this period Safe Flight 21 ADS concept demonstrations will be conducted to determine if and how ADS-B and ADS would operationally benefit users and the FAA and which technology is most suitable for this purpose.

If enough users equip with ADS-B avionics, the FAA will develop and install a compatible ADS ground system. In domestic airspace, ADS will depend upon the aircraft to automatically and frequently broadcast its position and velocity using ADS-B avionics.

Surveillance tracks derived from ADS-B data are expected to be more accurate than radar-derived tracks, thus improving the performance of controller decision support systems (DSSs) such as conflict probe, trial flight planning (a capability that evaluates pilot requests for revised flight paths for potential conflict with other flights), and FAST. Such improvements will help expedite traffic flow in the NAS.

Should users equip, ADS-B for air-air surveillance will be implemented in domestic and oceanic airspace. ADS-B is anticipated to support air-air surveillance by means of a cockpit display of traffic information (CDTI) that shows the position of all ADS-B-equipped aircraft nearby as a reference for tactical maneuvering, self-separation, and station-keeping. This will greatly enhance situational awareness in the cockpit. In domestic airspace, pilots are expected to use ADS-B air-air surveillance for situational awareness and limited shared responsibility for separation. These capabilities are expected to primarily benefit air carrier and cargo operations, but would be helpful to all of aviation as well. ADS-B avionics will not be required to operate in the NAS. In oceanic airspace, ADS-B may also be approved as a means for pilots to conduct in-trail climbs, descents, and passing maneuvers.

16.1.3 Surveillance Architecture Evolution—Step 3 (2003–2006)

En Route Domain. The Mode-S and ATCBI-6 SSRs will be upgraded with the All Purpose Structured EUROCONTROL Radar Information Exchange (ASTERIX) surveillance and weather message transfer protocol that was developed by the European Civil Aviation States to standardize data communications between surveillance and automation systems. This upgrade will allow the aircraft navigational system and waypoint data received in GICB replies to be processed. Mode-S sensors will receive a service life extension.

The ARTCC automation system will be upgraded to use GICB and ADS data for controller tools and displays (see Section 19, En Route). Installation of the ATCBI-6 SSRs will be completed.

Oceanic Domain. Installation of communications, and automation equipment to support ADS-A will begin. Current longitudinal separation standards between suitably equipped aircraft could be reduced in some areas by using ADS-A and other controller tools.

Terminal Domain. Mode-S SSRs will be upgraded with ASTERIX. The ASR-11's SSR will be upgraded with SI capability and the ASTERIX standard interface protocol. This will enable the ASR-11 SSR to send the aircraft position, velocity, and next waypoint data received via the GICB message to the STARS automation. STARS will be upgraded to use GICB and ADS data for controller displays (see Section 23, Terminal).

Tower/Airport Surface Domain. Installation of the new surface surveillance and conflict detection system will continue. If enough users equip with ADS-B avionics, installation of about 600 passive ADS ground stations with multi-lateration capability for airport surface surveillance will begin at approximately 150 airports. The multi-lateration capability enables the ADS system at an airport to determine the position of aircraft equipped with Mode-A/C/S transponders.

ADS-B avionics, which use WAAS and LAAS information, will provide the ADS source to precisely monitor the surface movement of ADS-B-equipped airport traffic. Due to its expected accuracy, LAAS is preferred for surface surveillance. The airport surface ADS system will interface with the STARS automation and displays to provide precision surface surveillance and warn tower controllers of impending runway incursions and other ground traffic problems. The STARS automation system will be capable of processing the ADS data. AMASS will receive a service life extension to ensure its viability.

16.1.4 Surveillance Architecture Evolution—Step 4 (2007–2010)

En Route Domain. If enough users equip with ADS-B avionics, the architecture plans for the installation of 20 passive ground stations in airspace not covered by radar. This capability will provide extended en route surveillance coverage for ADS-B-equipped aircraft. An additional 96 passive ADS ground stations will be installed in the en route airspace covered by radar.

Oceanic Domain. Implementation of ground-based and airborne communications and automation equipment to support ADS-A and ADS-B air-air surveillance will continue. Oceanic airspace users will benefit through greater flexibility, increased user-preferred routes and climbs, and greater capacity.

Terminal Domain. If enough users equip, passive ADS ground stations will be installed to provide ADS for up to 150 terminal areas. Target data from the ADS ground stations will be processed for display on TRACON controller workstations. The ADS system will also be used for monitoring instrument approaches to closely spaced parallel runways.

Tower/Airport Surface Domain. AMASS functionality will be incorporated into the tower automation system and installation of ADS ground stations will be completed. Installation of the new surface surveillance and conflict detection system also will be completed.

16.1.5 Surveillance Architecture Evolution—Step 5 (2011–2015)

En Route Domain. En route surveillance will be provided by SSRs and ADS. FAA-funded replacement of primary en route radars is not contemplated.

Terminal Domain. A next-generation terminal radar (multipurpose airport radar (MPAR)), which incorporates primary radar, SSR, and terminal Doppler weather radar capabilities, will begin to replace the existing systems starting about 2015.

Tower/Airport Surface Domain. ASDE systems will be decommissioned at the end of their service lives. Surface surveillance will rely on ADS surveillance with multi-lateration or other more cost-effective technologies for preventing runway incursions.

16.2 Summary of Capabilities

The evolution of surveillance capabilities is depicted in Figure 16-2**.**

Air Surveillance

The ADS-B concept is expected to provide an important air-air surveillance capability. Aircraft equipped to receive ADS-B transmissions will be able to display the position of all ADS-B-equipped aircraft in their proximity on CDTI displays. This capability will improve aircrew situational awareness, increase approach and departure efficiencies, and improve oceanic maneuvering. It

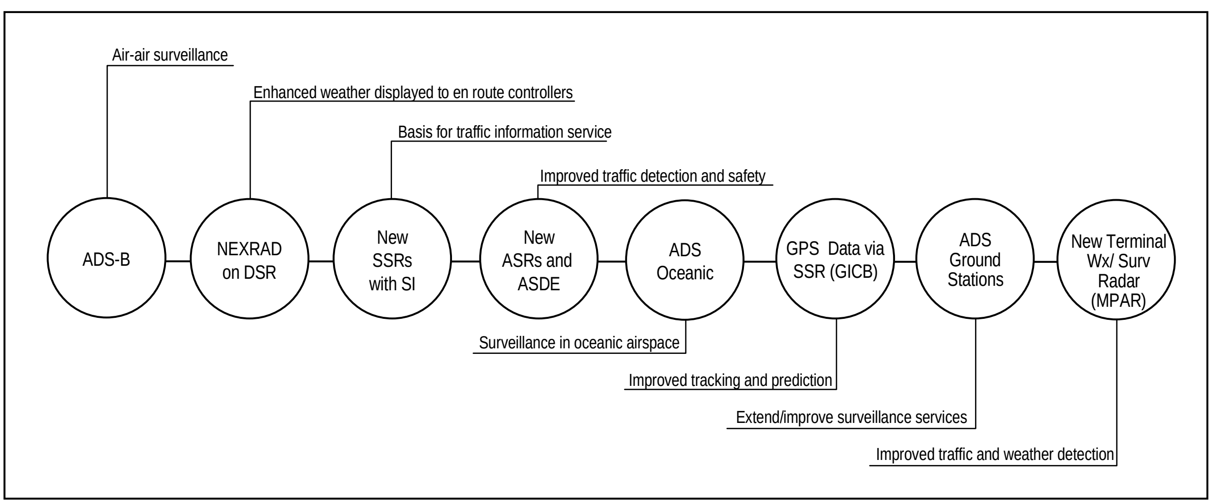

Figure 16-2. Surveillance Capabilities Summary

will enable pilots to assume responsibility for separation in certain circumstances.

Air Traffic Control System

Weather data from next-generation weather radars (NEXRAD) will be available to en route controllers via WARP, enabling long-range primary radars to be phased out. Primary radars will continue in use in terminal airspace and for airport surface surveillance. SSRs will continue in use in both terminal and en route airspace.

ADS will be introduced to provide a surveillance capability in oceanic airspace. The capability is based upon ADS-A, which uses position reports transmitted from FANS-1/A- or ATN-equipped aircraft via SATCOM, HFDL, or other subnetworks.

The terminal primary radar system will become all-digital with significantly improved capabilities, such as better detection of small aircraft at low altitudes and dedicated weather detection and processing. Primary radar for surface surveillance, coupled with conflict prediction capability, will be installed at a significant number of airports to improve surface operations and safety.

All SSRs will have an SI with GICB capability to elicit position and velocity (presumably GPS-derived) from the navigation system of suitably equipped aircraft via the Mode-S transponder. The resultant tracking accuracy will improve the performance of controller automation tools, such as conflict probe and requested flight path (trial planning), which support pilot routing and rerouting preferences.

Implementation of ADS in the domestic airspace (based on ADS-B) will enable surveillance services to be extended to new areas and improved in existing areas. ADS will support surface operations, thereby improving airport utilization during reduced visibility conditions. In conjunction with AMASS, ADS will increase protection against runway incursions. ADS will also improve airport utilization by providing the capability to monitor simultaneous approaches to closely spaced parallel runways in all weather conditions.

16.3 Human Factors

The surveillance systems themselves are not expected to require significant human factors engineering. However, the addition of the new surveillance capabilities (such as those associated with GICB messages and ADS-B, data and target fusion, and new mapping techniques) is expected to levy considerable human factors requirements on the ATC automation displays, aircrews, and controllers. The associated human factors effort will focus on the impact of new surveillance technologies, equipment, and methods on pilots, controllers, and maintainer interfaces, including:

- Identifying informational requirements and integrating information from new or multiple sources (such as the integration of ADS surveillance data with other radar data) in ways to facilitate development or modification of essential DSSs
- Application of reduced minimum separation standards for the controller and aircrews
- Prototyping changes to tasks and procedures that take advantage of new surveillance capabilities (such as SI and increased surveillance accuracy derived from GPS data).

The surveillance capabilities envisioned for the future (such as authorizing an aircrew to use ADS-B CDTI for self-separation) will require development of suitable cockpit displays and procedures. Controllers will require DSS tools to assist them in monitoring and appropriately interceding to ensure safe operations.

16.4 Transition

Primary Radars

Information from en route primary radar systems will not be used for ATC after NEXRAD weather data become available on ARTCC controller displays. It is expected that those radars required by DOD (ARSR-4s, some interior radars, and the FPS-117 radars in Alaska) will be supported by DOD until the end of service life, although current agreements call for FAA maintenance. Terminal primary radars will be retained to provide independent surveillance. The principal transitions are:

- Complete deployment of ASDE-3, ARSR-4, and ASR-9 equipment
- Replace ASR-7 and -8 radars with ASR-11

- Decommission the primary en route radars (ARSR -1, -2, -3, FPS) not required in accordance with FAA/DOD joint agreements
- Deploy new airport surface movement detection equipment with conflict prediction capability
- Perform a service life extension for ASR-9 and ASDE-3/AMASS radars
- Decommission any remaining en route primary radars (ARSR-4, FPS-117)
- Replace ASR-9 and -11 radars with a new terminal radar that includes SSR and terminal Doppler weather radar (TDWR) capability.

Secondary Radars

The SSRs will be retained to provide cooperative surveillance compatible with Mode-A/C transponders and redundancy in case dependent surveillance is interrupted. All SSRs will feature SI capability in order to utilize GICB transponder replies. The principal transitions are:

- Deploy remaining PRM systems
- Upgrade ASR-11 beacon with SI capability
- Replace en route ATCBIs-4 and -5 with ATCBI-6
- Leapfrog Mode-S from ASR-7 and -8 sites to ASR-9 sites
- Upgrade SSRs with GICB and ASTERIX capabilities
- Perform a service life extension for Mode-S radars.

Automatic Dependent Surveillance

ADS in domestic airspace will be based on ADS-B; in oceanic airspace, it will be based upon ADS-A. The Safe Flight 21 program is intended to support development and evaluation of ADS ground stations and the automation processing and display of ADS-derived information. If enough users equip with ADS-B avionics, a successful Safe Flight 21 program is expected to result in deployment of ADS ground stations. Figure 16-3 shows the transition schedule for the ADS systems. The principal transitions are:

- Install oceanic ADS-A capability

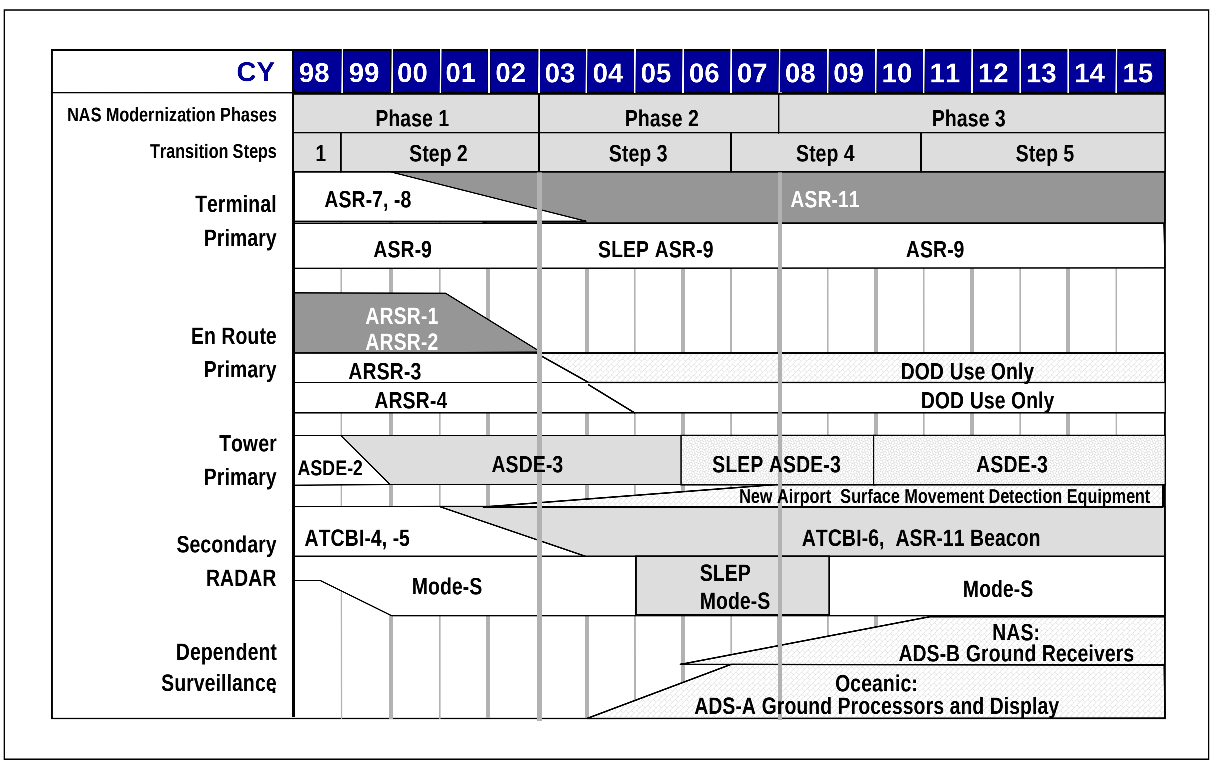

Figure 16-3. Major Surveillance Systems Transition

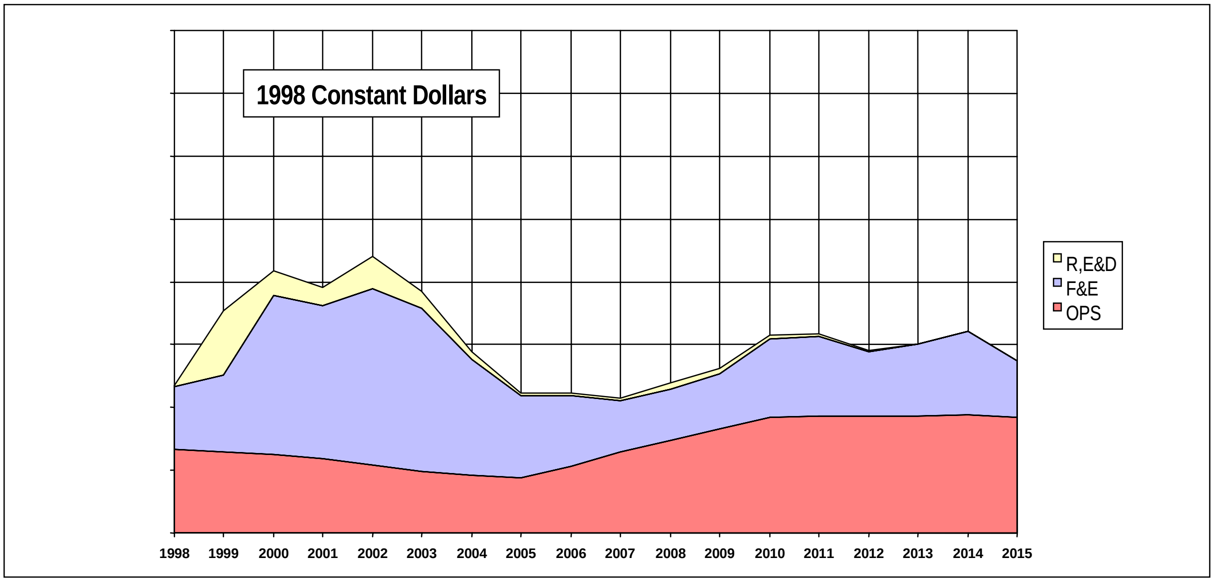

Figure 16-4. Estimated Surveillance Costs

- Complete ADS-B, Traffic Alert and Collision Avoidance System (TCAS), and CDTI standards for air-air surveillance
- Based on air-air surveillance, provide enhanced approach/departure and oceanic maneuvering services
- Develop ADS ground stations and improved surveillance systems via the Safe Flight 21 ADS-B program
- Deploy passive ADS ground stations:

  –To extend en route surveillance coverage to new areas

  –To en route, terminal, and airport surface locations throughout the NAS.

Other Surveillance Support:

- Complete AMASS implementation
- Perform service life extension for ASDE-3 and AMASS.

16.5 Costs

FAA estimates for research, engineering, and development (R,E&D), facilities and equipment (F&E), and operations (OPS) life-cycle costs for surveillance architecture from 1998 through 2015, are presented in constant FY98 dollars in Figure 16-4.

16.6 Watch Items

Decommissioning long-range primary radars depends on the availability of a WARP-provided NEXRAD weather data presentation on the new ARTCC displays now being installed. The WARP program is on schedule to be fully operational in all ARTCCs during Step 2.

ADS, based on ADS-A and ADS-B, is the major new ground surveillance capability envisioned for oceanic and domestic airspace, respectively. The initial development and evaluation of ADS, as well as ADS-B for air-air surveillance, depends on a number of significant technological developments involving avionics and ground equipment, and operational demonstrations planned for the Safe Flight 21 program, slated to occur during Step 2. Results of the Safe Flight 21 demonstrations will be subject to evaluation by both the FAA (through the Investment Analysis process) and users to determine subsequent investments and implementation in the NAS. It is evident that FAA and user decisions must be linked, because ADS is dependent on user investment in avionics. Avionics manufacturers are expected to create and integrate GPS-WAAS/LAAS receivers and ADS-B avionics for aircraft slated to participate in Safe Flight 21.

To use aircraft-derived position data for surveillance and tracking, the SSRs must all be configured with SI and ASTERIX in Steps 2 and 3. ATC automation systems will need to be configured to receive and process the enhanced surveillance data.

A major watch item is the rate at which users install ADS-B avionics during Steps 2, 3, and 4. The rate of equipage will be determined by factors such as avionics cost, availability, and perceived user benefits. The realization of expected user benefits, such as improved vectoring and sequencing and flexible routes, will depend on the rate of user equipage, procedural development, and FAA capability to process GPS data provided by aircraft avionics.

This architecture continues to provide surveillance, independent of user equipage with ADS-B. However, the FAA will deploy ADS-B listening (ground) stations as users equip with ADS-B avionics. A long transition period to ADS-B is anticipated. This requires the FAA to continue providing surveillance services using primary and secondary radar.

ADS in oceanic airspace will be based on position reports data linked by satellite, high frequency data link, or other subnetworks to FAA oceanic controllers. Airlines are ordering the FANS avionics needed for navigation and data link reporting via SATCOM. The FAA program to acquire the reciprocal necessary ground equipment and automation capabilities is under consideration.